Attorney Docket No.: 17561-067

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

Art Unit:	1762
Examiner:	B. Talbot
Appellants:	A. Soutar et al.
Serial No.:	09/282,729
Filed:	March 31, 1999
For:	PROCESS FOR SILVER PLATING IN PRINTED CIRCUIT BOARD MANUFACTURE

Boston, MA 02111
April 10, 2001

APPEAL BRIEF

ATTN: Board of Patent Appeals and Interferences
Commissioner for Patents and Trademarks
Washington, DC 20231

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By: _____
Barry J. Marenberg, Esq. (Reg. No. 40,715)

Sir:

This Brief is in furtherance of the Notice of Appeal mailed on November 13, 2000.

The fees required under 37 C.F.R. §1.17(c) and any required Petition for Extension of Time for filing this Brief and fees are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This Brief is transmitted in triplicate pursuant to 37 C.F.R. §1.192(a).

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(1) REAL PARTY IN INTEREST

The real party in interest is Fry's Metals, Inc. d/b/a Alpha Metals, Inc., the assignee of the application from all inventors.

(2) RELATED APPEALS AND INTERFERENCES

There are no other related appeals and interferences.

(3) STATUS OF CLAIMS

Claims 1-25 are pending (see Appendix of Claims). All claims were rejected under 35 U.S.C. § 103. Only claims 1 and 10 were rejected separately by the Examiner. The remaining claims in the application were not considered or at least were not rejected separately, but nevertheless were folded into the rejection of claim 1. By Advisory Action dated September 22, 2000, the Examiner maintained his rejection of claims 1-25 under 35 U.S.C. § 103.

(4) STATUS OF AMENDMENTS

The Appellants submitted an amendment after final rejection in a response dated September 12, 2000. In the Advisory Action dated September 22, 2000, the Examiner stated that the amendment would be entered upon the filing of a Notice of Appeal and Appeal Brief. The Notice of Appeal was filed on November 13, 2000.

(5) SUMMARY OF INVENTION

The claimed invention relates to the field of printed circuit board production, and specifically to a displacement immersion silver-plating process for forming a silver coating on a "bare board" in the production of a printed circuit board. The process of the present invention offers significant advantages over the prior art in that

it eliminates the use of reducing agents that reduce silver to undesirable silver metal, and eliminates the use of unstable ammonia based systems which may be explosive. (*see* Specification, page 5, lines 5-7)

Additionally, the process of the present invention eliminates the undesirable potential to coat onto solder mask protected areas of a printed circuit board precursors. In the past, printed circuit boards have been coated with a protective layer prior to passing to the component mounting stage. Problems with prior art protective layer coatings included the use of coatings which were not evenly applied and distributed, coatings were excessively expensive, contained ions, such as halides which tended to poison the plating composition, or were inadequate to withstand successive soldering steps.

A common prior art coating process is the electroless silver coating process. Electroless silver coatings generally utilized an ammonia-based complexing agent. Ammonia-based complexing agents are, as mentioned above, unstable and may be explosive. Electroless silver coatings have also been used with formaldehyde, which has the undesirable effect of reducing silver ions to form silver precipitate.

The present invention is more specifically directed to a displacement plating process for forming a silver coating on a surface consisting of a metal which is less electropositive than silver comprising: contacting the metal surface with an aqueous displacement plating composition comprising silver ions and a multidentate complexing agent in an aqueous vehicle and having a pH of from 2 to 12. (*see* Specification, page 11, lines 12-18)

The invention further relates to, and the claims are drawn to, an immersion displacement process, and <u>not</u> an electroless plating process, by which the plating composition is coated on a substrate wherein the metal conducting surfaces are less electropositive than silver (*see* Specification, page 19, lines 1-14) and which comprise

conductive metal pads or through holes of a bare board, and in which the substrate includes non-metallic areas which remain uncoated in the process. (*see* Specification, page 20, line 25 - page 21, line 6). As such, the coating is formed only on the electropositive metal surface and not on non-metallic areas of the boards, such as areas protected by solder mask. (*see* Specification, page 19, lines 10-14) The application recites that since electroless silver plating compositions coat silver onto non-metallic surfaces, they would have the potential to coat onto solder mask protected areas of a printed circuit board precursor, which is undesirable. (*see* Specification, page 19, lines 15-18)

In summary, claims 1-17 and 19-25 are directed to a process for providing a protective coating on metal conducting surfaces in the manufacture of printed circuit boards. Claim 18 is directed to a multi-step process for producing a bare board of a printed circuit board. The dependent claims further define the steps of the process, and also recite details of the process, namely, the types and amounts of coatings, complexing agents, surfactant, wetting agents, stabilizers, etc., which make up the aqueous displacement solution.

(6) ISSUES

1. Whether claims 1-9 and 11-25 are unpatentable as being obvious over U.S. Pat. No. 3,993,845 to Greenberg et al. (hereafter "Greenberg") in combination with Applicant's admitted state of the art (specification, pg. 1, line 8 - pg. 9, line 26)?

2. Whether claim 10 is unpatentable as being obvious over U.S. Pat. No. 3,993,845 to Greenberg et al. (hereafter "Greenberg") in combination with

Applicant's admitted state of the art (specification, pg. 1, line 8 - pg. 9, line 26), in combination with U.S. Pat. No. 4,171,393 to Donley et al. (hereafter "Donley")?

(7) GROUPING OF CLAIMS

The Appellants request separate consideration of independent claim 1 and its dependent claims, claims 2-17 and 19-25, as well as of independent claim 18. Claims 1-17 and 19-25 recite a process for providing a protective coating on a metal conducting surface of bare boards with an aqueous displacement plating composition. Claim 18, a second and only other independent claim, recites a multi-step process for producing a bare board of a printed circuit board. Thus, for purposes of this appeal, the claims do not stand or fall together.

Additionally, the Examiner, in folding the rejection of dependent claims 2-17 and 19-25 into a blanket rejection of all the claims, appears to not have given any real consideration to the limitations set forth in the dependent claims. For this additional reason, the claims do not stand or fall together because the dependent claims limit the scope of the claims from which they depend. Appellants submit that such separate consideration is warranted, in as much as the Board may decide to affirm the Examiner's decision on some, but not all claims, as each claims strand on its own. 37 C.F.R. § 1.192(c)(7); *In re Neilson*, 816 F.2d 1567, 2 U.S.P. Q2d 1525 (Fed. Cir. 1987).

(8) ARGUMENTS

1. **Whether claims 1-9 and 11-25 are unpatentable as being obvious over U.S. Pat. No. 3,993,845 to Greenberg et al. (hereafter "Greenberg") in combination with Applicant's admitted state of the art (specification, pg. 1, line 8 - pg. 9, line 26).**

Appellants respectfully request reversal of the rejection of the Office Action of August 14, 2000, and submit that the present claims are not rendered obvious by the teachings of Greenberg in combination with Applicant's state of the art for the following reasons:

Obviousness requires that there be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant. (*In re Kotzab*, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000)). To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not be based on applicant's disclosure. (*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). More recently, the Court of Appeals for the Federal Circuit held that a determination of obviousness based on a combination of references requires "actual evidence" of a suggestion, teaching or motivation to combine the teachings of the references. (*In re Dembiczak*, 50 U.S.P.Q.2d 1614 (Fed. Cir. 1999))

A rejection under 35 U.S.C. §103(a) would be appropriate if a designer of ordinary skill would have been motivated to modify a basic reference by deleting features thereof or by interchanging with or adding features from pertinent secondary references. In order for secondary references to be considered, there must be some suggestion in the prior art to modify the basic design with features from the secondary references. (In re Borden, 90 F.3d 1570, 1572, 39 USPQ2d 1524, 1526 (Fed. Cir. 1996)).

Description of the Prior Art Applied:

(1) The Greenberg Patent (U.S. Pat. No. 3,993,845)

Whereas Appellants' invention relates to and is claimed as relating to a process for providing a protective coating on printed circuit boards, Greenberg relates to a method of preparing a metallic copper-silver film on a non-metallic transparent substrate - specifically, glass. Greenberg does not disclose, or otherwise suggest the application of his patent's disclosure to the production of printed circuit boards. Greenberg teaches that transparent films comprising metallic copper and silver are prepared by depositing a copper film onto a transparent substrate by any conventional means and then contacting the copper film with a silver-containing solution, resulting in a copper-silver coated article. The non-metallic transparent substrate is stated to be a large sheet or plate of flat glass, which is used as a window to control solar energy. (Col. 2, lines 64-66; Col. 3, lines 44-46).

According to Greenberg, a thin metallic film of copper is deposited onto a non-metallic substrate by known direct-deposition techniques The conventionally coated article is then treated with a replacement solution comprising an ammoniacal silver salt and a complexing agent. In Greenberg, the surface of the non-metallic substrate to be coated is first cleaned by conventional cleaning procedures. The surface is then prepared for coating and is coated with a thin copper film by vapor

deposition, sputtering, electrolytic deposition or electroless deposition, with the preferred method for applying the copper film being electroless deposition. The copper-coated article is then contacted with an aqueous solution of an ammoniacal silver salt and a complexing agent.

Greenberg does not disclose or even hint at the use of his method in the manufacture of printed circuit boards. Moreover, Greenberg discloses the use of an aqueous solution containing ammonia, which, as disclosed the present invention, is highly undesirable since it may be explosive. (*see* Specification, page 9, lines 5-7 and page 10, lines 22-25).

(2) "Applicant's Admitted State Of The Art"

The Office Action of August 14, 2000 asserts that claims 1-25 are unpatentable as being obvious over Greenberg in combination with Applicant's admitted state of the art (Specification, pg. 1, line 8 - pg. 9, line 26). The "admitted state of the art", as described in Applicant's (now Appellant's) specification, is the use of ammonia-based solutions and electroless deposition of copper on the substrate prior to the application of the ammonia based solution, the very solution and deposition process avoided by the present invention.

In the Office Action, the Examiner recites that Applicant's admitted state of the art teaches that it is well known to use silver coatings on copper substrates utilized in printed circuit boards for protecting against oxidation. Applicant's specification on page 1, line 8 through page 9, line 26 provides a detailed summary of the prior art. The specification recites that processes are known which provide silver coatings on copper substrates using aqueous compositions which comprise electroless techniques (Specification, page 8, lines 9-11) (emphasis added). With regard to silver coatings, the Specification further recites that electroless silver coating processes, which can

also be used on non-metallic substrates, include a reducing agent, silver ions and a complexing agent.

The Specification on page 9 discusses that there are three common complexing systems for electroless silver plating processes, namely ammonia-based, thiosulphate-based or cyanide-based (emphasis added). A discussion then follows with examples demonstrating the disadvantages of each of these three complexing systems for electroless silver plating processes. (Specification, page 9, lines 5-13) Thus, while it is true that the specification does state that it is known generally to coat copper with silver, the specification, also details the disadvantages of the prior art. In particular, electroless silver plating using an ammonia-based silver salt solution is the very type of solution distinguished.

A. Greenberg does not disclose or in any way suggest a process for providing a protective coating on metal conducting surfaces of bare boards in the manufacture of printed circuit boards.

i. Greenberg's disclosure is limited to the application of a metallic copper-silver film on a non-metallic, transparent (glass) window.

Greenberg only discloses that a thin metallic film of copper is deposited onto a non-metallic, transparent article (a glass window to control solar energy, not a printed circuit board!), by a known direct-deposition technique, preferably the method of electroless deposition of copper over a flash silver film, as taught by U.S. Pat. No. 3,457,138. The coated article is then treated with a silver-containing replacement solution. According to Greenberg, silver from the solution replaces copper in the film, resulting in a film comprising copper and silver. (Col. 2, lines 53-59)

Greenberg discloses that the copper coated non-metallic, transparent article is then contacted with an aqueous solution of an ammoniacal silver salt and a

complexing agent. Greenberg recites that during the brief period of time in which the replacement solution is maintained in contact with the copper film, silver from the solution displaces a portion of the copper film, resulting in a metallic copper silver film. (Col. 3, lines 9-29) The ammoniacal silvering solution of Greenberg is prepared by intermixing a first solution containing an ammoniacal silver salt and a second solution containing a reducing agent. (Col. 4, lines 20-59) The reducing agent may be formaldehyde, dextrose, and an invert sugar or the like.

In sum, and even taking it in the best light, Greenberg is limited to application of the metallic copper film on a non-metallic, transparent surface, not a printed circuit board. Furthermore, Greenberg discloses the application of an ammoniacal silvering solution which is prepared by intermixing an ammoniacal silver salt and a reducing agent, which may be formaldehyde, dextrose, and an invert sugar or the like.

Overall, and most importantly, the claims of the present application are directed to a process for providing a protective coating on a metal conducting surface of a bare board with an aqueous displacement plating composition. (emphasis added) The present application recites the disadvantages of electroless deposition and thus may be considered to teach away from such deposition process. The present application also recites that the displacement plating step comprises contacting a metal surface with an aqueous displacement plating composition comprising silver ions and multidentate complexing agent in solution in an aqueous vehicle. The displacement plating step forms a coating on only the less electropositive metal surface and not on non-metallic areas of the board (Specification, page 19, lines 10-14). The present application recites that ammonia is disadvantageous since it is unstable and may be explosive. Thus, there is no ammonia present in the displacement plating composition of the present invention. (emphasis added). Furthermore, since reducing agents have the undesirable effect of reducing the silver

ions to silver metal, the displacement plating composition of the present invention does not require, and in fact should be free of, any reducing agent, such as formaldehyde or reducing sugars.

The present application teaches that since electroless silver plating compositions coat silver onto non-metallic surfaces of a bare board in the manufacture of printed circuit boards, they would have the potential to coat onto solder mask protected areas of a printed circuit board precursor, which is undesirable. The present application further states that the plating compositions of the present invention are more stable than plating compositions for use in electroless systems, which include, for example, formaldehyde and which reduce silver ions to form silver precipitate. The process of the present invention further recites that the plating composition is coated upon a substrate wherein the metal conducting surfaces are less electropositive than silver and which comprise conductive metal pads or through-holes of a bare board, and in which the substrate includes non-metallic areas which remain uncoated in the process.

ii. Greenberg only discloses the <u>replacement</u> of a portion of the copper film resulting in a metallic copper-silver film.

Greenberg recites that the silver containing replacement solution that is deposited on to the copper film on the non-metallic substrate <u>replaces</u> copper in the film, resulting in a film comprising copper and silver (Col. 2, lines 53-59) (emphasis added). More specifically, the non-metallic, transparent substrate is first cleaned and contacted with a sensitizing agent. The surface is then coated with a copper film, preferably by electroless deposition. The copper coated substrate is then contacted with a replacement solution comprising an aqueous solution of an ammoniacal silvering solution (comprised of a silver salt and a reducing agent) and a complexing

agent. During the brief period of time in which the replacement solution is maintained in contact with the copper film, silver from the solution silver from the solution replaces a portion of the copper in the film, resulting in a metallic copper-silver film. (Col. 3, lines 25-29; Col. 4, line4 - Col. 5, line 65;) The purpose of the metallic copper-silver film is to provide a silvery gray appearance on the transparent substrate for decreasing visible light transmittance through the transparent substrate. (Col. 2, lines 64-66; Col. 5, lines 59-60) This is apparently desirable to produce the windows with certain characteristics to which Greenberg is directed.

The present invention does not teach the replacement of copper by an electroless deposition of an ammoniacal silver salt solution. Rather, the present invention teaches a displacement plating process whereby metal atoms on the metal surface (which is less electropositive than silver) are oxidized by silver ions in the plating composition so that a layer of silver metal deposits on the surface of the metal substrate. (Specification, page 11, lines 12-22) A displacement plating process differs significantly from a replacement process. In a replacement process, as taught by Greenberg, a copper film on the substrate is replaced by silver from an ammoniacal silver-containing replacement solution and complexing agent which contact the substrate. (Col. 2, lines 54-59; Col. 3, lines 25-29). Alternatively, in a displacement plating process, as taught by the present invention, an aqueous silver coating having no ammonia or reducing agents therein, forms on the surface of the metal by a simple displacement reaction due to the relative electrode potentials of the oxidizable metal of the surface to be protected and of the silver ions respectively. (Specification, page 11, lines 12-22)

According to the process of the present invention, a protective silver metal layer is formed on all surface sites of metal oxidizable by silver, but not on non-metallic solderable sites. As a result, unlike an electroless deposition process in

which silver is coated on to non-metallic surfaces, the displacement plating process of the present invention is formed only on metallic surfaces that are less electropositive than silver and thus, solder mask protected pads and/or through holes on the substrate remain uncoated.

B. Greenberg, when combined with Applicant's admitted state of the art, does not render claims 1-9 and 11-25 obvious under 35 U.S.C. §103(a).

As noted above, Greenberg does not disclose or even suggest a process for providing a protective coating on metal conducting surfaces of bare boards in the manufacture of printed circuit boards, nor does Greenberg disclose or even suggest the steps of contacting the conducting surfaces with an aqueous displacement plating composition which comprises silver ions and a multidentate complexing agent in solution in an aqueous vehicle at a pH of from 2 to 12 to form a silver coating on the conducting surfaces on the printed circuit board.

Contrary to the Examiner's contention in the final Office Action, the Applicant's specification describes only that electroless silver plating processes are known, and then recites the disadvantages inherent in the electroless silver plating processes and in using ammonia-based plating compositions, the same type of process and composition described by Greenberg. There is no basis to combine Greenberg (which has nothing to do with printed circuit boards) with Applicant's prior art description, which states that the type of process and composition used has disadvantages. Even if it would have been obvious to combine them, the resulting "combination" is still the prior art described in Applicant's specification, that is, electroless deposition with an ammonia-based silver salt.

Accordingly, it would not have been obvious to one skilled in the art at the time the invention was made to have utilized the disclosure of Greenberg in combination with applicant's recited state of the art, to provide a protective coating on metal conducting surfaces on a bare board in the manufacture of printed circuit boards.

The present application includes two independent claims. Independent claim 1 recites a process for providing a protective coating on metal conducting surfaces of bare boards in the manufacture of printed circuit boards, comprising the steps of contacting the conducting surfaces with an aqueous displacement plating composition which comprises silver ions and a multidentate complexing agent in solution in an aqueous vehicle at a pH of from 2 to 12 to form a silver coating on the conducting surfaces. Second independent claim 18 is directed to a multi-step process for producing a bare board of a printed circuit board, and which includes the steps of:

i) providing, by a subtractive or additive process, exposed metal conductor traces and pads or through-holes on a substrate, said metal being less electropositive than silver;

ii) applying a mask to cover at least the said traces and leaving at least some of the pads or through-holes exposed, the mask being of an insulating composition; and

iii) forming a silver coating on the exposed pads or through-holes by contacting the metal surface with an aqueous displacement plating composition comprising silver ions and a multidentate complexing agent in solution in an aqueous vehicle and having a pH of from 2 to 12, to form a coating of silver on the metal surface.

The Examiner has not satisfied the requirements of *In re Dembiczak*, which held that a determination of obviousness based on a combination of references requires "actual evidence" of a suggestion, teaching or motivation to combine the teachings of the references. The Examiner's rejection should thus be reversed and the claims advanced to allowance.

Furthermore, while the Examiner stated in the Office Action that it would have been obvious to combine Greenberg with Applicant's admitted state of the art as there would have been an expectation of achieving similar results, that summary statement is untrue and without support. There are no "similar results" because, as stated in Applicant's specification, the problems of the prior art have been eliminated. Applicant's test results (Examples 1-8, page 22-28 of the Specification) further support Applicant's position that the pending claims are patentable over the purported combination of Greenberg and the admitted state of the art.

Thus, independent claims 1 and 18 are patentable over the cited art of record as applied to these claims. The Examiner's rejection should thus be reversed and claims 1 and 18 be determined by the Board to be allowable.

2. Whether claim 10 is unpatentable as being obvious over U.S. Pat. No. 3,993,845 to Greenberg et al. (hereafter "Greenberg") in combination with Applicant's admitted state of the art (specification, pg. 1, line 8 - pg. 9, line 26), in combination with U.S. Pat. No. 4,171,393 to Donley et al. (hereafter "Donley").

A. With regard to claim 10, it would not have been obvious for one skilled in the art at the time the invention was made to have modified the Greenberg coating bath by not incorporating a reducing agent as evidenced by Donley.

In the final Office Action of August 14, 2000, claim 10 was rejected under 35 U.S.C. §103(a) as being unpatentable over Greenberg in combination with Applicant's admitted state of the art (Specification, pg. 1, line 8 - page 9, line 26) further in combination with Donley. Claim 10 depends directly from independent claim 1 and further recites that the displacement plating composition is free of reducing agent which reduces the silver ions to silver metal and free of halide ions.

As a dependent claim that depends directly from independent claim 1, claim 10 incorporates all the limitations of independent claim 1.

Donley is directed to an improved method for the electroless plating of metals by a sustainable direct metal-metal ion displacement reaction on porous metal surfaces. Donley, like Greenberg, has nothing to do with printed circuit board production, to which all of Applicant's claims are directed. The Donley method is applicable whenever the plating metal is more electronegative than the porous metal surface on which it is to be plated. The porous metal must be a catalyst for the displacement reaction, and the pores of the porous metal surface must be large enough to enable plating solution to wet the internal surfaces of the pores and to enable substrate cations of the porous metal to diffuse out of the pores of into the bulk of the plating solution. However, the pores must not be so large as to allow plating solution to circulate freely through them (Col. 3, lines 42-48). The method of Donley comprises immersing an article having a porous metal surface in an alkaline aqueous solution containing cations of the plating metal. No chemical reducing agent for the metal cations is required in the plating bath.

According to Donley, the term "porous metal surface" is meant to define metal surfaces that will sustain a plating reaction without the necessity for a chemical reducing agent in the plating solution (Col. 3, lines 64-68). Donley further teaches that in order for the plating reaction of the invention to be electroless, it is necessary that the metal substrate itself serve as the reducing agent for the cations of the plating metal. (Col. 2, line 67-Col. 3, line 3) As such, Donley recites that the metal substrate must have a higher oxidation potential in the electromotive force series than the plating metal, i.e., the plating metal must be more electronegative than the metal substrate. (Col. 3, lines 3-7)

The Office Action stated that Greenberg in combination with Applicant's admitted state of the art (Specification, pg. 1, line 8 - page 9, line 26) fails to teach a solution free of a reducing agent. The Office Action stated that Donley teaches a plating bath requiring no reducing agent, and that it would have been obvious for one skilled in the art at the time the invention was made to have modified Greenberg's coating bath by not incorporating a reducing agent as evidenced by Donley because of the expectation of achieving similar success.

Above, Appellants have argued that it clearly would not have been obvious to combine the window-treating disclosure of Greenberg and the "admitted state of the art" for the reasons given above. To add a third prior art reference, Donley, which, like Greenberg, does not disclose or suggest its application to the manufacture of printed circuit boards in any way, goes too far and in fact evidences the nonobviousness of the claimed invention, recited in claim 10.

Accordingly, claim 10 of the present invention is not obvious over Greenberg in combination with Applicant's admitted state of the art (specification, pg. 1, line 8 - page 9, line 26) and further in combination with Donley. The Examiner has not satisfied that requirements of *In re Dembiczak*, which states that a determination of obviousness based on a combination of references requires "actual evidence" of a suggestion, teaching or motivation to combine the teachings of the references. The Examiner's rejection should thus be reversed and claim 10 be determined by the Board to be allowable.

3. The Dependent Claims

As recited above, the Examiner did not give any real, or at least separate consideration, to the limiting recitations of the dependent claims. For the reasons to be discussed below, each of the dependent claims are believed to be allowable, and the Examiner's blanket rejection of all the dependent claims should be reversed.

Claim 2 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically, claim 2 further recites that the process of claim 1 further comprises forming a protective coating on a substrate wherein the metal conducting surfaces are less electropositive than silver and which comprise conductive metal pads or through-holes of a bare board, and in which the substrate includes non-metallic areas which remain uncoated in the process. As noted above, Greenberg has nothing to do with printed circuit boards and is directed to the deposition of copper film and an ammoniacal silvering solution on a non-metallic transparent article (a glass window). In addition, neither Greenberg nor Appellant's admitted state of the art , does not disclose, teach or suggest the step of forming a protective coating on a substrate wherein the metal conducting surfaces are less electropositive than silver and which comprise conductive metal pads or through-holes of a bare board, and in which the substrate includes non-metallic areas which remain uncoated in the process. Thus, claim 2 is allowable and the Examiner's rejection of claim 2 should be reversed.

Claim 3 depends from claims 1 or 2 and thus incorporates all the limitations of those claims therein. Specifically, claim 3 recites that in the process recited, the metal surface comprises copper. While disclosing a copper film, Greenberg is directed to and limited to the deposition of copper film and an ammoniacal silvering solution on a glass window. Neither Greenberg, nor the admitted state of the art disclose, teach or suggest the step of forming a protective coating on a substrate wherein the metal conducting surface comprises copper in the process recited in claim 1 or 2. Thus, claim 3 is allowable and the Examiner's rejection of claim 3 should be reversed.

Claim 4 depends from claims 1 and thus incorporates all the limitations of claim 1 therein. Specifically, claim 4 recites that in the process recited, the complexing agent is present in a higher molar amount than the silver ions. Greenberg is directed to the deposition

of a copper film and an ammoniacal silvering solution upon a non-metallic transparent article. Neither Greenberg, nor the admitted state of the art, teach or suggest the step of forming a protective coating on a substrate, wherein the coating comprises a complexing agent present in a higher molar amount than the silver ions. The present invention specifically discloses that the complexing agent is present in a higher molar amount so that all the silver ions will be complexed for the step of contacting the conducting surfaces of a bare board in the manufacture of printed circuit boards with the aqueous displacement composition. (Specification, page 12, lines 7-13) Thus, claim 4 is allowable and the Examiner's rejection of claim 4 should be reversed.

Claim 5 depends from claim 1 and thus incorporates all the limitations of claim 1 therein. Specifically, claim 5 recites that in the process recited, the silver ions are present in the displacement plating composition at a concentration of from 0.06 to 32 g/l. Even if Greenberg were combinable with Appellant's admitted state of the art, which it is not, in any case, neither Greenberg, nor such admitted state of the art disclose, teach or suggest an aqueous displacement plating composition for coating on metal conducting surfaces of bare boards in the manufacture of printed circuit boards, comprising silver ions present at a preferred concentration of from 0.06 to 32 g/l. Thus, claim 5 is allowable and the Examiner's rejection of claim 5 should be reversed.

Claim 6 depends from claim 4 and indirectly from claim 1 and thus incorporates all the limitations of these claims. Specifically, claim 6 recites that in the process recited, the complexing agent is present in the composition in an amount of from 0.1 to 250 g/l. Even if Greenberg were combinable with Appellant's admitted state of the art, which it is not, in any case, neither Greenberg, nor such admitted state of the art disclose, teach or suggest an aqueous displacement plating composition for coating on metal conducting surfaces of bare

boards in the manufacture of printed circuit boards, and which comprises a complexing present at a preferred concentration of from 0.1 to 250 g/l. Thus, claim 6 is allowable and the Examiner's rejection of claim 6 should be reversed.

Claim 7 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically, claim 7 recites that in the process recited, the complexing agent is selected from the group consisting of ethylenediamine tetra-acetic acid, diethylenetriamine penta-acetic acid and N, N, N′, N′-tetrakis(2-hydroxy propyl)ethylene diamine. Greenberg is not directed to forming a silver coating on conducting surfaces of a bare board in the manufacture of printed circuit boards. Even if Greenberg were combinable with Appellant's admitted state of the art, which it is not, in any case, neither Greenberg nor Appellants' state of the art disclose, teach or suggest the complexing of silver ions with a complexing agent selected from the group consisting of ethylenediamine tetra-acetic acid, diethylenetriamine penta-acetic acid and N, N, N′, N′-tetrakis(2-hydroxy propyl)ethylene diamine. These complexing agents have the properties of preventing the formation of water insoluble precipitates under the aqueous and pH conditions of the composition. (Specification, page 12, lines 14-16) Thus, claim 7 is allowable and the Examiner's rejection of claim 7 should be reversed.

Claim 8 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically, claim 8 recites that in the process recited, the displacement coating composition comprises a surfactant, wetting agent, stabilizer, and further that the displacement coating composition also includes a material selected from the group consisting of a grain refiner or tarnish inhibitor. Greenberg has nothing to do with the coating of bare boards in the manufacture of printed circuit boards. Furthermore, Greenberg does not disclose or suggest contacting conducting surfaces of a bare board with an aqueous displacement plating composition, as explained above. Even if Greenberg were somehow combinable with

Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 8 is allowable and the Examiner's rejection of claim 8 should be reversed.

Claim 9 depends from claim 8 and indirectly from claim 1 and thus incorporates all the limitations of these claims. Specifically, claim 9 recites that in the process recited, the surfactant is incorporated in the displacement plating composition at a concentration of from 1 to 15 g/l. Greenberg is not directed to forming a silver coating on conducting surfaces of bare boards in the manufacture of printed circuit boards. Also, neither Greenberg, nor the admitted state of the art, disclose or suggest the incorporation of a surfactant into the displacement plating composition at the claimed concentration range. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 9 is allowable and the Examiner's rejection of claim 9 should be reversed.

Claim 11 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically, claim 11 further recites that in the process recited, the step of contacting the metal surfaces with the aqueous displacement plating composition is done by spraying or by dip-coating in an immersion bath and further in which excess composition is reused in the process. Neither Greenberg nor Appellant's admitted the state of art discloses or suggests the step of contacting the metal surfaces with an aqueous displacement plating composition by spraying or dip-coating in an immersion bath nor the reuse of excess composition in the process. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in

any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 11 is allowable and the Examiner's rejection of claim 11 should be reversed.

Claim 12 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically, claim 11 further recited that in the process claimed, the metal conducting surfaces are contacted with the aqueous displacement plating composition for from 10 seconds to 10 minutes, at a temperature of from 10°C to 60°C. Neither Greenberg nor Appellant's admitted state of the art disclosures or suggests contacting the metal surfaces with an aqueous displacement plating composition for from 10 seconds to 10 minutes, at a temperature of from 10°C to 60°C. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 12 is allowable and the Examiner's rejection of claim 12 should be reversed.

Claim 13 depends from claim 1 and thus incorporates all the limitations of claim 1. Claim 13 further recites that in the process claimed, the silver coating is less than 0.5 μm thick. Greenberg is only directed to the application of an ammoniacal silvering solution on a piece of glass. Greenberg does not disclose or suggest (nor does Appellant's admitted state of the art) the application of a silver coating of less than 0.5μm in thickness on metal conducting surfaces of bare boards in the manufacture of printed circuit boards. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 13 is allowable and the Examiner's rejection of claim 13 should be reversed.

Claim 14 depends from claim 1 and thus incorporates all the limitations of claim 1. Claim 14 further recites that in the process claimed, prior to the displacement plating composition step, the metal conducting surfaces are cleaned by contacting with an acidic cleaning solution in an acid cleaning step. Greenberg is only directed to the application of an ammoniacal silvering solution on a piece of glass. Neither Greenberg nor Appellant's admitted state of the art can be held to teach or suggest the cleaning of metal conducting surfaces by contacting with an acidic cleaning solution in an acid cleaning step. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 14 is allowable and the Examiner's rejection of claim 14 should be reversed.

Claim 15 depends from claim 1 and thus incorporates all the limitations of claim 1. Specifically claim 15 further recites that in the process claimed, prior to contacting the metal surface elements with the displacement plating composition, the metal conducting surfaces undergo a micro-etching step, and wherein between the micro-etching step and the displacement plating composition step, there is an additional acid rinse step. Greenberg is only directed to the application of an ammoniacal silvering solution on a piece of glass. Neither Greenberg nor Appellant's admitted state of the art disclosure or suggest a micro-etching step on the metal conducting surfaces. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 15 is allowable and the Examiner's rejection of claim 15 should be reversed.

Claim 16 depends from claim 1 and thus incorporates all the limitations of claim 1. Claim 16 further recites that in the process claimed, the silver coated metal surface is subsequently rinsed and, optionally, dried. Greenberg is only directed to the application of an ammoniacal silvering solution on a piece of glass. Neither Greenberg nor Appellant's admitted state of the art can be held to teach or suggest a silver coated metal surface that is subsequently rinsed and, optionally, dried. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 16 is allowable and the Examiner's rejection of claim 16 should be reversed.

Claim 17 depends from claim 1 and thus incorporates all the limitations of claim 1 therein. Claim 17 further recites that in the process claimed, a component is subsequently soldered directly to the silver coating previously recited in claim 1. Greenberg is only directed to the application of an ammoniacal silvering solution on a piece of glass. Neither Greenberg nor Appellant's admitted state of the art disclosure or suggest the soldering of a component directly to the silver coating which has been applied on conducting surfaces of a bare board in the manufacture of printed circuit boards. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 17 is allowable and the Examiner's rejection of claim 17 should be reversed.

Claim 19 depends from claim 2 directly and indirectly from claim 1 and thus incorporates all the limitations of both these claims. Claim 19 further recites that in

the process claimed, the non-metallic areas are coated with solder-mask. Greenberg is only directed to coating a copper film and an ammoniacal silvering solution upon a piece of glass. Unlike the present invention, Greenberg has nothing to do with printed circuit boards. Neither Greenberg nor Appellant's admitted state of the art disclosures or suggests a process wherein non-metallic areas on the bare board substrate are coated with solder mask in the process claimed. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 19 is allowable and the Examiner's rejection of claim 19 should be reversed.

Claim 20 depends directly from claim 4 and indirectly from claim 1, and thus incorporates all the limitations of these two claims. Specifically, claim 20 further recites that in the process claimed, the aqueous displacement plating composition contains at least twice the molar amount of said complexing agent than of the silver ions. Greenberg is only directed to the deposition of a copper film and an ammoniacal silvering solution upon a piece of glass. Neither Greenberg nor Appellant's admitted state of the art disclosures or suggests the step of forming a protective coating on a substrate, in which the aqueous displacement plating composition contains at least twice the molar amount of complexing agent that of silver ions. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 20 is allowable and the Examiner's rejection of claim 20 should be reversed.

Claim 21 depends from claim 1 and thus incorporates all the limitations of claim 1. Claim 21 further recites that in the process claimed, the silver ions are

present in said displacement plating composition at a concentration of from 0.1 to 25 g/l. Neither Greenberg nor Appellant's admitted state of the art disclose or suggest an aqueous displacement plating composition for coating on conducting surfaces of bare boards in the process claimed for the manufacture of printed circuit boards, and one in which the composition comprising silver ions present in a preferred concentration of from 0.1 to 25 g/l. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 21 is allowable and the Examiner's rejection of claim 21 should be reversed.

Claim 22 depends from claim 1 and thus incorporates all the limitations of claim 1 therein. Claim 22 further recites that in the process claimed, the silver ions are present in the displacement plating composition at a concentration of from 0.5 to 15 g/l. Neither Greenberg nor Appellant's admitted state of the art disclosure or suggest an aqueous displacement plating composition for coating on conducting surfaces of bare boards in the process claimed for the manufacture of printed circuit boards, and one in which the composition comprises silver ions present in a preferred concentration of from 0.5 to 15 g/l. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 22 is allowable and the Examiner's rejection of claim 22 should be reversed.

Claim 23 depends from claim 1 and thus incorporates all the limitations of claim 1 therein. Claim 23 further recites that in the process claimed, the recited complexing agent is present in the composition in an amount of from 10 to 100 g/l.

Neither Greenberg nor Appellant's state of the art disclosures or suggests an aqueous displacement plating composition for coating on metal conducting surfaces of bare boards in the process claimed for the manufacture of printed circuit boards, and in which the aqueous displacement plating composition comprises a complexing agent present in a preferred concentration of from 10 to 100 g/l. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 23 is allowable and the Examiner's rejection of claim 23 should be reversed.

Claim 24 depends from claim 1 and thus incorporates all the limitations of claim 1 therein. Claim 24 further recites that in the process claimed, the metal surface is contacted with said aqueous displacement plating composition for from 10 seconds to 10 minutes, at a temperature in the range 15°C to 50°C. Neither Greenberg nor Appellant's admitted state of the art discloses or suggests contacting the metal surface of a bare board with an aqueous displacement plating composition for from 10 seconds to 10 minutes at a temperature in the range 15°C to 50°C. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 24 is allowable and the Examiner's rejection of claim 24 should be reversed.

Claim 25 depends directly from claim 14 and indirectly from claim 1, and incorporates all the limitations of these two claims. Claim 25 further recites that in the process claimed, a rinse step is used in the process after said acid cleaning step and prior to said displacement plating composition step. Neither Greenberg nor

Appellant's admitted state of the art discloses or suggests the further step of cleaning the metal conducting surfaces by contacting with an acidic cleaning solution in an acid cleaning step and in which a rinse step is used after the acid cleaning step and prior to the displacement plating composition step. Even if Greenberg were somehow combinable with Appellant's admitted state of the art, in any case, neither Greenberg, nor such admitted state of the art, disclose or suggest the recited components of the displacement plating composition. Thus, claim 25 is allowable and the Examiner's rejection of claim 25 should be reversed.

CONCLUSION

For all the above reasons, Appellants submit that appealed claims 1-9 and 11-25 are patentable over the Examiner's rejection of these claims based upon Greenberg in combination with Applicant's admitted state of the art. Additionally, for all the above reasons, Appellants submit that appealed claim 10 is patentable over Greenberg in combination with Applicant's admitted state of the art and further in combination with Donley.

Although Appellants believe that they have paid the fees due in connection with this submission, the Commissioner is authorized to credit any overpayment of charge or deficiencies to the undersigned's account, Deposit Account No. 50-0311, Ref. No. 17561-067.

Respectfully submitted,

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(9) APPENDIX OF CLAIMS ON APPEAL

1. A process for providing a protective coating on metal conducting surfaces of bare boards in the manufacture of printed circuit boards, comprising the steps of contacting the conducting surfaces with an aqueous displacement plating composition which comprises silver ions and a multidentate complexing agent in solution in an aqueous vehicle at a pH of from 2 to 12 to form a silver coating on the conducting surfaces.

2. A process according to claim 1 wherein the process further comprises forming a protective coating on a substrate wherein the metal conducting surfaces are less electropositive than silver and which comprise conductive metal pads or through-holes of a bare board, and in which the substrate includes non-metallic areas which remain uncoated in the process.

3. A process according to claim 1 or claim 2, in which the metal surface comprises copper.

4. A process according to claim 1 in which the complexing agent is present in a higher molar amount than the silver ions.

5. A process according to claim 1 in which the silver ions are present in the displacement plating composition at a concentration of from 0.06 to 32 g/l.

6. A process according to claim 4 in which the complexing agent is present in the composition in an amount of from 0.1 to 250 g/l.

7. A process according to claim 1 in which the complexing agent is selected from the group consisting of ethylenediamine tetra-acetic acid, diethylenetriamine penta-acetic acid and N, N, N′, N′-tetrakis(2-hydroxy propyl)ethylene diamine.

8. A process according to claim 1 in which the displacement coating composition comprises surfactant, wetting agent, stabilizer, and wherein the displacement coating composition also includes a material selected from the group consisting of grain refiner or tarnish inhibitor.

9. A process according to claim 8 in which surfactant is incorporated in the displacement plating composition at a concentration of from 1 to 15 g/l.

10. A process according to claim 1 in which the displacement plating composition is free of reducing agent which reduces the silver ions to silver metal and free of halide ions.

11. A process according to claim 1 in which the step of contacting the metal conducting surfaces with the aqueous displacement plating composition is by spraying or dip-coating in an immersion bath and in which excess composition is reused in the process.

12. A process according to claim 1 in which the metal conducting surfaces are contacted with the aqueous displacement plating composition for from 10 seconds to 10 minutes, at a temperature of from 10°C to 60°C.

13. A process according to claim 1 in which the silver coating is less than 0.5 μm thick.

14. A process according to claim 1 in which prior to the displacement plating composition step, the metal conducting surfaces are cleaned by contacting with an acidic cleaning solution in an acid cleaning step.

15. A process according to claim 1 in which prior to contacting the metal surface elements with the displacement plating composition, the metal conducting surfaces undergo a micro-etching step, and wherein between the micro-etching step and the displacement plating composition step, there is an additional acid rinse step.

16. A process according to claim 1 in which the silver coated metal surface is subsequently rinsed and, optionally, dried.

17. A process according to claim 1 in which a component is subsequently soldered directly to the silver coating.

18. A multi-step process for producing a bare board of a printed circuit board including the steps of:

i) providing, by a subtractive or additive process, exposed metal conductor traces and pads or through-holes on a substrate, said metal being less electropositive than silver;

ii) applying a mask to cover at least the said traces and leaving at least some of the pads or through-holes exposed, the mask being of an insulating composition; and

iii) forming a silver coating on the exposed pads or through-holes by contacting the metal surface with an aqueous displacement plating composition comprising silver ions and a multidentate complexing agent in solution in an aqueous vehicle and having a pH of from 2 to 12, to form a coating of silver on the metal surface.

19. A process according to claim 2, wherein the non-metallic areas are coated with solder-mask.

20. A process according to claim 4, wherein said aqueous displacement plating composition contains at least twice the molar amount of said complexing agent than of said silver ions.

21. A process according to claim 1, wherein said silver ions are present in said displacement plating composition at a concentration of from 0.1 to 25 g/l.

22. A process according to claim 1, wherein said silver ions are present in the displacement plating composition at a concentration of from 0.5 to 15 g/l.

23. A process according to claim 1 in which the complexing agent is present in the composition in an amount of from 10 to 100 g/l.

24. A process according to claim 1 in which the metal surface is contacted with said aqueous displacement plating composition for from 10 seconds to 10 minutes, at a temperature in the range 15°C to 50°C.

25. A process according to claim 14 in which a rinse step is used in the process after said acid cleaning step and prior to said displacement plating composition step.